

CLAIMS

1. A leak detector for detecting leakage of liquid stored in a tank based on fluctuation in a level of the liquid, comprising:
 - a liquid inlet/outlet portion through which the liquid flows in and out;
 - a flow-rate measuring unit arranged at an upper end of the liquid inlet/outlet portion and configured to measure an amount of flow occurring along with the fluctuation; and
 - a liquid retaining portion positioned above the flow-rate measuring unit and including a space in which liquid that has flown in through the liquid inlet/outlet portion is retained, wherein
 - a lower end of the leak detector is detachably attached to a bottom plate of the tank, and
 - an upper end of the leak detector is arranged in such a manner that the space of the liquid retaining portion communicates with an interior of the tank, and is supported in a through opening provided in a top plate of the tank in such a manner that the leak detector is movable in a vertical direction.
2. A leak detector for detecting leakage of liquid stored in a tank based on fluctuation in a level of the liquid, comprising:
 - a liquid retaining portion including a space configured to retain liquid flown into the leak detector, the liquid flown being a part of the liquid in the tank;
 - a flow path portion through which the space of the liquid retaining portion in communicates with an interior of the tank and through which the liquid flows in and out of the leak detector along with the fluctuation;
 - a flow-path opening/closing unit configured to freely open and close at least one end of the flow path portion;
 - a flow-rate measuring unit configured to measure an amount of liquid flowing inside the flow path portion; and
 - a calibrating unit configured to calibrate the flow-rate measuring unit.
3. A leak detector for detecting leakage of liquid stored in a tank based on fluctuation in a level of the liquid, comprising:

- a liquid retaining portion including a space in which liquid flown therein is retained, the liquid flown being a part of the liquid in the tank;
 - a flow path portion through which the liquid flows between the space of the liquid retaining portion and an inside of the tank along with the fluctuation;
 - a flow path opening/closing unit configured to freely open and close at least one end of the flow path portion;
 - a flow-rate measuring unit configured to measure an amount of the liquid flowing inside the flow path portion; and
 - a calibrating unit configured to calibrate the flow-rate measuring unit, wherein
 - a lower end of the leak detector is detachably arrested to a bottom plate of the tank, and
 - an upper end of the leak detector is configured such that the space of the liquid retaining portion is in communication with an interior of the tank, and is supported in a through opening provided in a top plate of the tank in such a manner that the leak detector is movable in a vertical direction.
4. The leak detector according to claim 1 or 3, wherein
 - the lower end of the leak detector is detachably arrested to the bottom plate of the tank with a magnet.
5. The leak detector according to claim 1 or 3, wherein
 - the upper end of the leak detector is supported in the through opening through an elastic member.
6. The leak detector according to claim 2 or 3, wherein
 - the flow-rate measuring unit includes
 - at least one temperature detecting unit configured to detect temperature of liquid inside the flow path portion;
 - a heating unit configured to heat the liquid inside the flow path portion; and
 - a controlling unit configured to control heating temperature of the heating unit for heating the liquid so that the temperature of liquid inside the liquid

retaining portion and the temperature of the liquid inside the flow path portion become equal.

7. The leak detector according to claim 2 or 3, wherein
the calibrating unit calibrates the flow-rate measuring unit based on an output signal corresponding to temperature of liquid being inside the flow path portion without flowing.
8. The leak detector according to claim 1 or 3, further comprising
a protective member configured to protect the flow-rate measuring unit and the liquid retaining portion from the liquid, and arranged outside the flow-rate measuring unit and the liquid retaining portion, wherein
the protective member is formed with a metal having a thermal expansion coefficient in a range such that a distance between the flow-rate measuring unit and the bottom plate is maintained invariant.
9. The leak detector according to claim 8, wherein
the protective member is formed with a material identical to a material of the tank.
10. The leak detector according to claim 1, further comprising an intermediate member arranged between the leak detector and the bottom plate, and formed with a magnetic material.
11. The leak detector according to claim 1, wherein
the flow-rate measuring unit includes
a flow path portion for the liquid arranged between the space of the liquid retaining portion and the liquid inlet/outlet portion;
at least one temperature detecting unit configured to detect temperature of liquid inside the flow path portion;
a heating unit configured to heat the liquid inside the flow path portion;
and

a controlling unit configured to control heating temperature of the heating unit for heating the liquid so that the temperature of liquid inside the liquid retaining portion and the temperature of the liquid inside the flow path portion become equal.

12. The leak detector according to claim 2 or 3, wherein
the flow path opening/closing unit includes a solenoid valve and is configured to open and close at least one end of the flow path portion.

13. A leak detecting system comprising:
a leak detector configured to detect leakage of liquid stored in a tank based on fluctuation in a level of the liquid, and including

a liquid inlet/outlet portion through which the liquid flows in and out;
a flow-rate measuring unit arranged at an upper end of the liquid inlet/outlet portion and configured to measure an amount of flow occurring along with the fluctuation; and

a liquid retaining portion positioned above the flow-rate measuring unit and including a space in which liquid that has flown in through the liquid inlet/outlet portion is retained, wherein

a lower end of the leak detector is detachably arrested to a bottom plate of the tank, and

an upper end of the leak detector is arranged in such a manner that the space of the liquid retaining portion communicates with an interior of the tank, and is supported in a through opening provided in a top plate of the tank in such a manner that the leak detector is movable in a vertical direction; and

a controller configured to control driving of the leak detector.

14. A leak detecting system comprising:

a leak detector configured to detect leakage of liquid stored in a tank based on fluctuation in a level of the liquid, and including

a liquid retaining portion including a space configured to retain liquid flown into the leak detector, the liquid flown being a part of the liquid in the tank;

a flow path portion through which the space of the liquid retaining portion in communicates with an interior of the tank and through which the liquid flows in and out of the leak detector along with the fluctuation;

a flow-path opening/closing unit configured to freely open and close at least one end of the flow path portion;

a flow-rate measuring unit configured to measure an amount of liquid flowing inside the flow path portion; and

a calibrating unit configured to calibrate the flow-rate measuring unit; and

a controller configured to control driving of the leak detector.

15. A leak detecting system comprising:

a leak detector configured to detect leakage of liquid stored in a tank based on fluctuation in a level of the liquid, and including

a liquid retaining portion including a space in which liquid flown therein is retained, the liquid flown being a part of the liquid in the tank;

a flow path portion through which the liquid flows between the space of the liquid retaining portion and an inside of the tank along with the fluctuation;

a flow path opening/closing unit configured to freely open and close at least one end of the flow path portion;

a flow-rate measuring unit configured to measure an amount of the liquid flowing inside the flow path portion; and

a calibrating unit configured to calibrate the flow-rate measuring unit, wherein

a lower end of the leak detector is detachably arrested to a bottom plate of the tank, and

an upper end of the leak detector is configured such that the space of the liquid retaining portion is in communication with an interior of the tank, and is supported in a through opening provided in a top plate of the tank in such a manner that the leak detector is movable in a vertical direction; and

a controller configured to control driving of the leak detector.